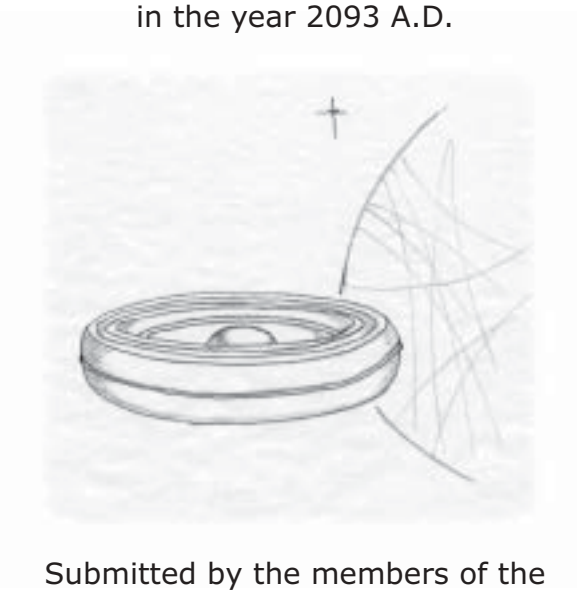
DSE: ALPHA
(Deep Space Explorer: Alpha)

A self-sufficient U.S. Space Colony
in orbit around the Jovian moon, Europa
in the year 2093 A.D.



Submitted by the members of the
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THE PROJECT

1. How the SpaceX Team conducted research for the DSE project

One of the main objectives of the Collierville Middle School Space Exploration Club (SpaceX) is to submit an entry in the Ames Research Center's Annual Space Settlement Contest. SpaceX meets on the second and fourth Fridays of every month after school to work on this project. Our meetings include a summary of science news for the previous two weeks, such as the discovery of the planetoid Sedna (almost 8.5 trillion miles from the sun), or the observance of five planets during the month of March (Mercury, Venus, Mars, Jupiter and Saturn). We also studied about new technologies (such as carbon nanotubes) and future propulsion systems (such as antimatter or fission reactors).

Part of our SpaceX meeting is always devoted to internet research on topics related to the project. SpaceX is divided into research teams. Each team is given an assignment or a topic and after the teams have completed their research, all the teams are brought back together for a brainstorming session. All of our ideas for the *DSE: Alpha* were decided during these brainstorming sessions. Majority ruled with every decision, although most of the time we all agreed and the decisions were easy.

2. Decision to name the project DSE: Alpha

Early in the school year, we (SpaceX Club members) decided that our colony should be around Europa, because of the likely abundance of water below the surface of that moon. So the early name of the project was Europa III, but the focus of the project began to change as we studied our solar system and the stars. We thought about a lunar-orbiting colony, or a Mars-orbiting one, or even a colony around Pluto. We decided that our project could still be based around Europa, but could include a lot more than just exploring Europa. There's so much in space that we do not know, but there's so much that we could know if we just decide to make the commitment and do it. We might not have a Europa colony in our lifetime, but someday a future generation will.

Our project was almost complete (under the name Europa III) when it

happened. Astronomers from Caltech and Yale University announced the discovery of Sedna (a planetoid at the edge of our solar system). Our team discussed the discovery of Sedna at our SpaceX meeting and decided to have an "emergency" meeting to discuss how we could put Sedna into our project. At that point, our focus changed from Europa to "Europa and Beyond". We brainstormed ideas and Alex mentioned "Deep Space Explorer". We all liked it and it became DSE for short. Since this is the first DSE, Alpha was added to the name, and the result is *DSE: ALPHA*. A new section on Sedna was added to the project, the exploration section of the project was adjusted to include Sedna, and the result is the project that you are about to see.

I hope you have as much fun reading our project as we had doing it!

3. Information about NEOs (Near-Earth Objects)

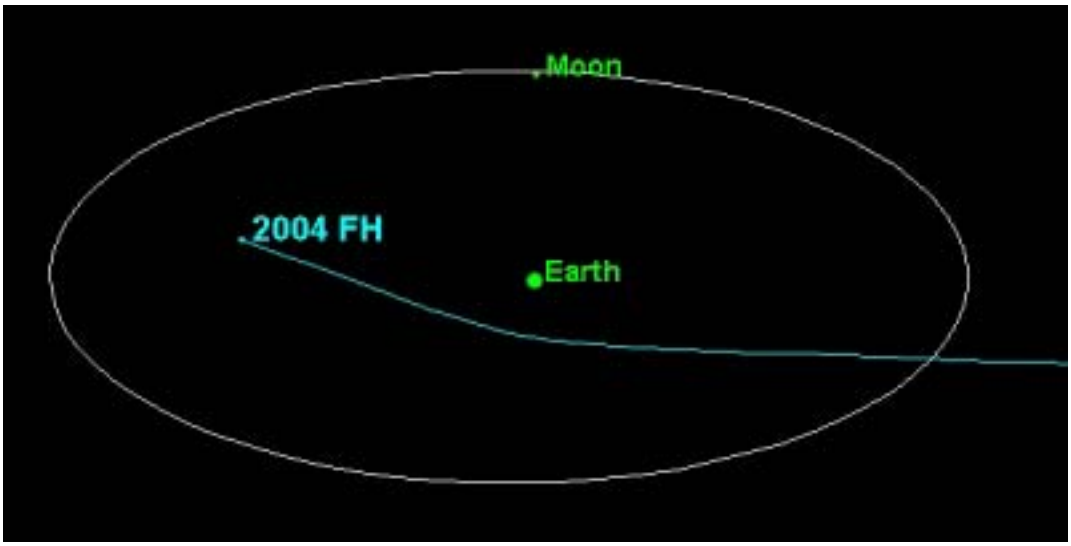


FIGURE 1: Asteroid 2004 FH passes about 43,000 km (26,500 miles) above the Earth's surface on March 18, 2004. Earth's gravity bends the trajectory of the asteroid by about 15 degrees. The asteroid crosses from one side of the Moon's orbit to the other in 31 hours. Source: http://neo.jpl.nasa.gov/

How scary is that! What would happen if a bigger asteroid than Asteroid 2004 FH (whose path is shown in Figure 1 above) was found approaching Earth. And what if we detected that asteroid too late to do anything about it, or if it was too big to stop even if we knew about it in advance? What happened to the dinosaurs 65 million years ago could happen to us! One of the purposes of the *DSE: ALPHA* colony is to provide a place for the people of Earth to establish a community to "carry on" if such a catastrophe should happen to our planet. More about this part of *DSE: ALPHA* can be

found in Section 10 of this project.

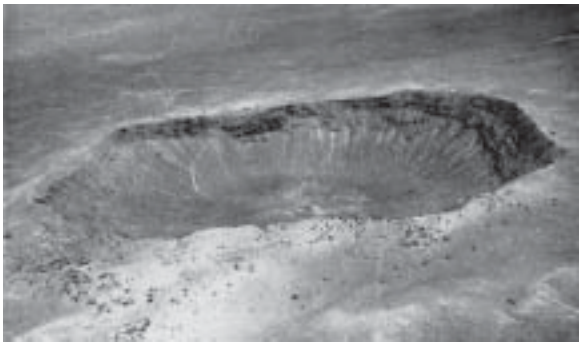


FIGURE 2: Meteor Crater, Arizona, USA. From the Smithsonian Scientific Series (1929), taken by the U.S. Army Air Service. Public domain.

Near-Earth Objects (NEOs) are comets and asteroids that have been nudged by the gravitational attraction of nearby planets into orbits that allow them to enter the Earth's neighborhood. Composed mostly of water ice with embedded dust particles, comets originally formed in the cold outer planetary system while most of the rocky asteroids formed in the warmer inner solar system between the orbits of Mars and Jupiter. The giant outer planets (Jupiter, Saturn, Uranus, and Neptune) formed from an agglomeration of billions of comets and the left over bits and pieces from this formation process are the comets we see today. Likewise, today's asteroids are the bits and pieces left over from the initial agglomeration of the inner planets that include Mercury, Venus, Earth, and Mars.

Because of the ongoing search efforts to find nearly all the large NEOs, objects will occasionally be found to be on very close Earth approaching trajectories. Great care must then be taken to verify any Earth collision predictions that are made. Given the extremely unlikely nature of such a collision, almost all of these predictions will turn out to be false alarms. However, if an object is verified to be on an Earth colliding trajectory, it seems likely that this collision possibility will be known several years prior to the actual event. Given several years warning time, existing technology could be used to deflect the threatening object away from Earth. The key point in this mitigation process is to find the threatening object years ahead of time so that an orderly international campaign can be mounted to send spacecraft to the threatening object. One of the techniques suggested for deflecting an asteroid includes nuclear fusion weapons set off above the surface to slightly change the asteroid's velocity without fracturing it. This would cause a change in the asteroid’s motion. A very small velocity change in the asteroid (only a few millimeters per second), acting over several years, can cause the asteroid to miss the Earth entirely. However, the trick is to gently nudge the asteroid out of harm's way and not to blow it up. Blowing it up would only make a

bigger problem when all the pieces encounter the Earth. Another option could be to place large solar sails on a small threatening object so that the pressure of sunlight could eventually redirect the object away from its predicted Earth collision.

NASA has developed a team to study what should be done to find near-Earth objects less than 1 kilometer in size. While impacts by these smaller objects would not be expected to cause global devastation, impacts on land and the tsunamis resulting from ocean impacts could still cause massive regional damage and still pose a significant long-term hazard.

The Torino Scale is a rating which has been developed to determine the hazard rating of NEOs. On this scale, 10 is the biggest risk to Earth, with 0 showing "no likely consequences". Asteroid 2004 FH was a 1 on this scale. 1 on the scale merits careful monitoring. Higher ratings tell us that we should be even more concerned.

4. Information about Europa

FIGURE 3: Europa. Source: http://www.solarviews.com/raw/jup/europa.gif

Discovery: Jan 7, 1610 by Galileo Galilei
Diameter (km): 3,138
Mass (kg): 4.8e22
Mass (Earth = 1): 0.0083021
Surface Gravity (Earth = 1): 0.135
Mean Distance from Jupiter (km): 670,900
Mean Distance From Jupiter (Rj): 9.5
Mean Distance from Sun (AU): 5.203
Orbital period (days): 3.551181
Rotational period (days): 3.551181
Density (gm/cm3): 3.01
Orbit Eccentricity: 0.009
Orbit Inclination (degrees): 0.470
Orbit Speed (km/sec): 13.74
Escape Velocity (km/sec): 2.02
Visual Albedo: 0.64
Surface Composition: Water Ice

The sixth largest moon in our Solar System, Europa confounds and intrigues scientists. Few bodies in the Solar System have attracted as much scientific attention as this moon of Jupiter because of its possible subsurface ocean of water. The more we learn about this icy moon, the more questions we have. Because the nature of science is to ask questions, we cannot resist the mystery of Europa and its potential for possessing an ocean.

Europa looks like broken glass that is repaired by an icy glue oozing up from below. Low ridges, straight and curved, crisscross the surface. Flows and fractures, pits and frozen "puddles" - all hint at a unique geologic history. Large circular features could be the sites of impacts or the result of upwelling of material from beneath the surface. Making sense of this chaotic landscape is a challenge to planetary scientists.

"How old is the surface? How were the cracks and other features made? What is under the ice?" To answer them, we collect data and make careful observations, applying what we know about geology, physics, and chemistry. Geologists figure out the age of a surface by counting the impact craters formed where comets, meteorites, and other debris hit the surface.

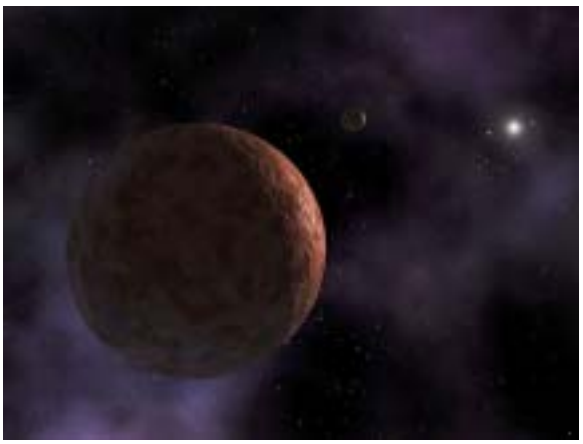
Earth's Moon has young and old craters literally everywhere, which tells us that it has been geologically inactive for more than a billion years. Earth has been impacted at least as many times as the Moon, but Earth's surface has been smoothed by active geological processes such as plate tectonics and volcanic flows, and by constant weathering. Like our Moon, Jupiter's satellites Ganymede and Callisto are heavily cratered – evidence of very old and inactive surfaces. On Europa, however, only a few large craters have been identified. Unless Europa has somehow avoided these impacts, which is unlikely, relatively recent events must have smoothed over the craters.

We see evidence of geologic action on Europa. Small blocks of crust float like icebergs over an invisible sea. Some blocks are tilted, others rotated out of place. Dark bands of ice and rock spread outward from a central ridge. What is the cause for this activity? In a gravitational tug of war of incredible dimensions, Europa is pulled in different directions by Jupiter and by the planet's other moons in a process called tidal flexing. Over one Europan day, it stretches and compresses up to several tens of meters. The outer surface of Europa is a rigid sphere. Imagine Earth covered by a blanket of ice that traps the oceans below. In the course of a day, these oceans rise and fall. This is what happens to Europa. The flexing of Europa's surface continues until the brittle crust cracks. We don't know what happens when the crust fractures. The process may be slow and steady, advancing only centimeters at a time – or, it may

cause ice volcanoes or geysers to erupt violently, showering the surface with material from below.

Another interesting possibility arises from this tidal flexing of Europa. Heat generated by the expansion and contraction may be enough to melt part of the crust underneath the surface, creating lakes or oceans below. The possibility of liquid water just below Europa's surface naturally leads to the question of whether life could have evolved there. Scientists have discovered marine life on Earth that thrives in the deep ocean near hydrothermal vents. This discovery provides us with a model for how similar organisms might survive on Europa. However, liquid water is just one of life's key ingredients. Many other factors, including organic material and a continuous energy source, must be present. Even if there is no ocean currently on Europa, one may have existed in the past, perhaps leaving fossilized remains to be found by a future mission.

5. Information about Sedna (2003 VB12)



Artist's conception of the cold distant Sedna. the sun is a tiny point of light 8 billion miles away from the red planetoid. A hypothesized tiny moon appears nearby. SOURCE: http://www.gps.caltech.edu/~mbrown/sedna/

On 15 March 2004, astronomers from Caltech, Gemini Observatory, and Yale University announced the discovery of the coldest, most distant object known to orbit the sun (possibly the first object in the long-hypothesized Oort cloud). The object was found at a distance 90 times greater than that from the sun to the earth – about 3 times further than Pluto, the most distant known planet.

Sedna is the most distant solar system object ever discovered. It is twice as far from the sun as any other solar system object and three times farther than Pluto or Neptune. Standing on the surface of Sedna, you could block the entire sun with the head of a pin held at arm's length.

Even more interestingly, the orbit of Sedna is extreme elliptical, in contrast to all

of the much closer planets, and it takes 10,500 years to circle the sun.

We can measure Sedna's size using a thermal telescope, which measures the heat coming from the surface. We know how far away Sedna is, so we know that the surface temperature is about 400 degrees below zero Fahrenheit. A large object of that temperature will give off much more heat than a small object of that temperature (just light a match and a bonfire are the same temperature, but a bonfire keeps you much warmer at night because it is so much bigger). Sedna is, at most, about 1800 km in diameter: about halfway in size between Pluto and the largest known Kuiper belt object, Quaoar. Even though all we know for certain is that Sedna is smaller than 1800 km, we have evidence which suggests that the size might be pretty close to this number. We are virtually certain that the size is larger than the 1250 km size of Quaoar.

Sedna is not a planet. It is a planetoid. It is difficult for scientists to have to define a word that everybody thought they already knew the meaning of. But discoveries such as Sedna, Quaoar, 2004 DW are blurring the line between planets, asteroids, and comets. These objects are all big, so what are they? We prefer to call them planetoids. To us, a planetoid is any round object in the solar system that is not big enough to be considered a planet (actually we don't know that any of these objects are round, but it is a reasonable assumption).

6. Information about Deep Space

One of the main missions of DSE: Alpha is the exploration of deep space. Other than the exploration of Sedna, the mining and exploration of Europa and the harvesting of power from the asteroids of the Van Allen Belt, here are just a few of the projects that have the attention of the *DSE: Alpha Discovery Omega Team*.

6a. Neptune's Capture and Destruction of Its Largest Moon

Neptune's satellites all travel in one direction with the strange exception of Triton's retrograde orbit. Triton is believed to have been a small planet like Pluto until it was "captured" by Neptune, instead of being a natural by-product of Neptune's formation.

Further, due to Triton's retrograde orbit, Neptune's gravitational pull is causing the moon's orbit to degrade. Astronomers in some far distant future, will be able to witness one of two incredible displays of planetary destructiveness. Neptune will either cause Triton to break apart, causing the largest moon to become debris or another ring around

the planet. Or, the more extreme display of Triton colliding into Neptune may occur.

6b. Uranus' Dark Moon

Umbriel is the fourth largest satellite orbiting Uranus. Unlike the other moons orbiting Uranus, this moon is strangely dark. In fact, it reflects only about half the light of the other moons. Given the distance of Uranus from Earth, Voyager 2 is the only spacecraft has visited this planet. Further, Umbriel has two bright white spots on an otherwise dark surface. These bright spots on Umbriel could be recent impact craters. There is much left to learn about this satellite and its mysterious past.

6c. Jupiter: The Failed Star?

Jupiter is often described as not only a gas giant, but "almost a sun" or a "failed star." Surprisingly, Jupiter and Sol share similar atmospheric contents:

Sol:	**Hydrogen–**78 percent;	Helium–19.8 percent
Jupiter:	**Hydrogen–**89 percent;	Helium–11 percent

A key difference between the two bodies, however, lies in their core temperatures. Sol's core is about 16 million Celsius, while Jupiter's core is 33,000 Celsius. Further, while Jupiter does transmit twice the heat energy it absorbs from the sun, much of this heat has been stored on the planet since its formation.

In order for Jupiter to achieve star status, it would need to be about sixty times more massive. Such mass would theoretically lead to the planet's collapse under its own gravity, forcing thermonuclear reactions that would convert the gas giant into a star. Had such an event occurred during our Solar System's formation, the formation of life on Earth would have been dramatically different due to the increased temperatures on our planet.

6d. Comet/Asteroid Wilson-Harrington

This comet was discovered by Albert G. Wilson and Robert G. Harrington on November 19, 1949. What is of particular interest is this object's apparent move towards inactivity. While originally classified as a comet, Wilson-Harrington has also

been classified as Asteroid 4015. According to the International Astronomical Union, Wilson-Harrington is one of only three objects to share such a cross listing.

The existence of such objects is a reminder of the constant changes in our solar system and its inhabitants. A rendezvous with the comet/asteroid is one of the mission targets of the *Discovery Omega Team*.

7. Information on Endangered Species

The scientists and researchers of *DSE: Alpha ZORM (Zoo/Farm)* are working diligently to protect endangered species. We're working to ensure that the Earth our future generations inherit will be home to rhinos, tigers, giant pandas, whales, and other wildlife species, as well as people.

Every species loss diminishes the diversity of life on Earth with untold consequences for the web of life. Yet, at present rates of extinction, as much as 20 percent of the world's species could be gone in the next 30 years.

For more about how *ZORM* is working to save endangered species, read Section 10b. of this project.

8. Launching/Construction of the *DSE: Alpha* colony

The year is 2093 and the construction of *DSE: Alpha* has just been completed, but our mission began many years ago. The United States began pioneering space in the year 2020, with the completion of the first permanent Lunar Base (*US Luna One*) in Mare Tranquillitatis and the first permanent Martian Base (*US Olympus Mons Exploratory Base*) five years later in 2025, near the base of Olympus Mons. In 2035, the United States completed construction of the *Mars Orbiting Laboratory I* space community, followed by *Mars Orbiting Laboratory II* space community in 2040.

Most of the materials used in the construction of *DSE: Alpha* were mined, refined and launched from the moon and from the asteroids of the Van Allen Belt, with construction being accomplished by workerbots in Europa orbit. A smaller space station with temporary living quarters for construction supervisor humans was placed in orbit around Europa. A temporary base could not be erected on the Europan surface because of violent weather patterns. Turbulence beneath the frozen surface and gravitational storms on the surface caused by Jupiter create tsunami-type ripples in the ice, making Europa very unstable.

DSE: Alpha consists of three concentric toruses constructed around a central core. The three toruses were constructed separately, and then placed one inside the other during the final phase of construction.

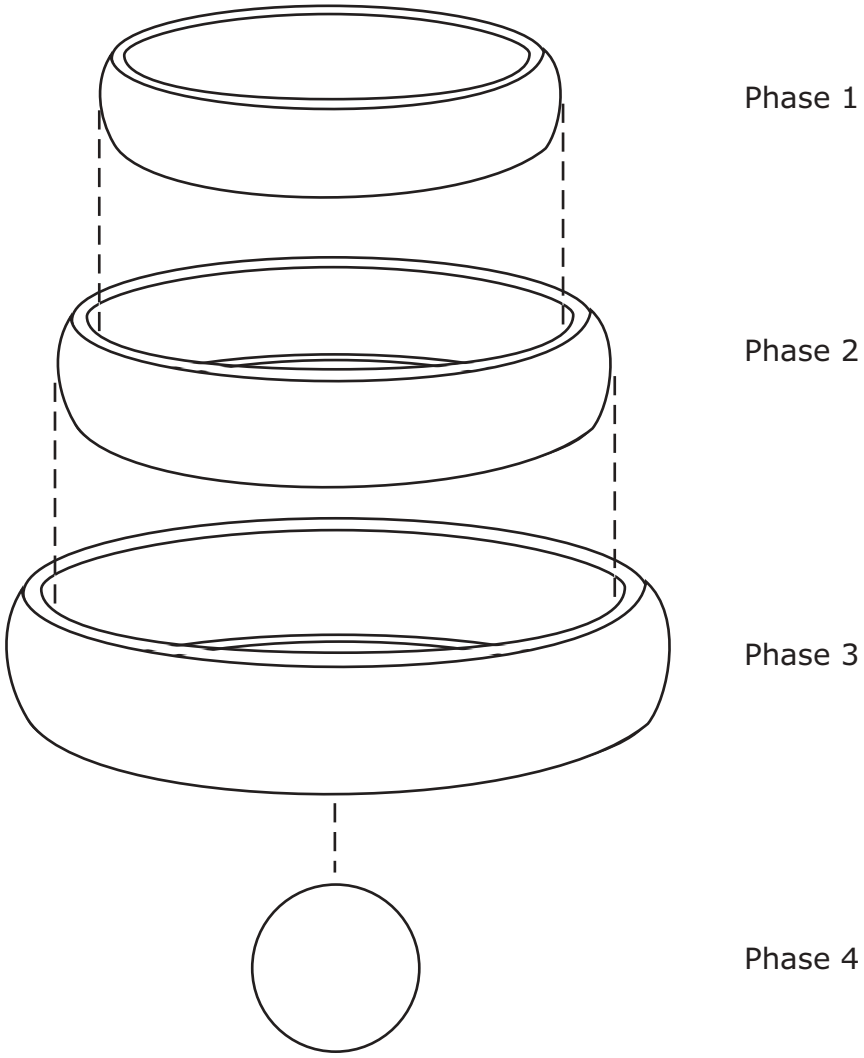


ILLUSTRATION 1: Construction of DSE: Alpha toruses. Phase 1 fits inside Phase 2, which fits inside Phase 3, and Phase 4 then fits inside the concentric toruses.

9. Missions of *DSE: Alpha*

The United States of America chartered D*eep Space Explorer: Alpha* with multiple missions. The original mission of *DSE: Alpha* is to provide Asteroid Defense for the people of Earth and the interplanetary colonies, communities and outposts of Earth. Mission Two of *DSE: Alpha* is to provide research and development of Endan-

gered Species Protection. Mission Three of the colony is to provide research, development, mining and processing of resources found on Europa, asteroids and other deep space locations. The final mission of the colony is to explore deep space under the banner of the Interplanetary Aeronautics and Space Administration (IASA) of the United States.

10. Procedures for accomplishing our missions

10a. Mission One: Asteroid Defense

DSE: Alpha can provide Earth and each of the interplanetary colonies, communities, and outposts of Earth with surveillance monitoring of asteroids in the Van Allen Belt between Mars and Jupiter. Surveillance can also be accomplished from *Mars Orbiting Laboratory I* and *II*. Ion drive tugships can be deployed from *DSE: Alpha* or either of the Mars Orbiting Laboratories. These tugs are equipped with rocket packs which can be attached to targeted asteroids. Controlled rocket burns can nudge targeted asteroids out of a collision course with Earth or its colonies. Tugships can also be equipped with explosives to be detonated above a targeted asteroid to help redirect its trajectory.

10b. Mission Two: Endangered Species Protection: ZORM

The scientists, physicians, and technicians of *DSE: Alpha*'s ZORM (Zoological Orbiting Research Module) maintain a zoological park in the colony where endangered species are studied and housed. Embyroes of endangered species have been transported to ZORM in cryogenic chambers where they are stored for future deployment back to Earth at a time in the future when the environment might be more hospitable for their development and growth. Selected species have been released from the cold storage of the cryogenic chambers and now populate the grounds of ZORM. Habitat areas have been established in ZORM to simulate the environments that the species would encounter on Earth. Sample habitats include rain forest, tundra, desert, plains, woodlands, wetlands, freshwater lake, and ocean. Endangered botanical species are also nurtured in ZORM.

10c. Mission Three: Mining

DSE: Alpha has mining operations in several areas: [1] water mining on Europa;

[2] thermal energy from the volcanoes of Io; and [3] mining minerals from the asteroids of the Van Allen Belt.

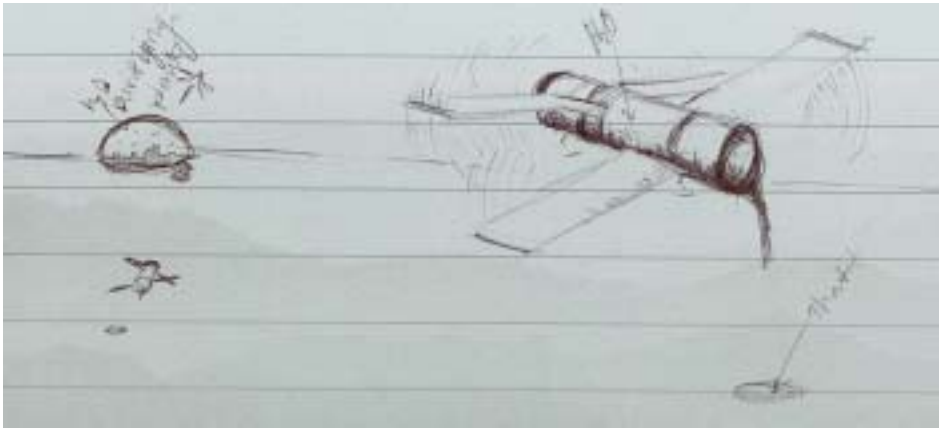
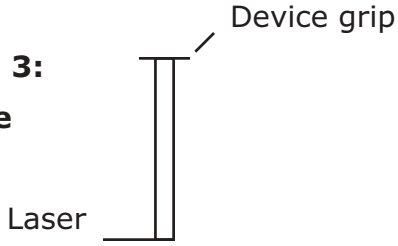


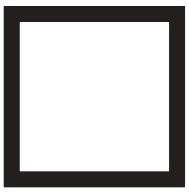
ILLUSTRATION 2: Hummingbird water collectors hovering above the Europan surface. Illustration by Kelly Baldwin.

DSE: Alpha water mining operations on the surface of Europa are accomplished in two ways. The first is water collection by way of "hummingbirds". Well shafts have been drilled through the surface of the Europan ice crust to the freshwater oceans below. These well shafts are as long as 13 miles in some areas. Most are 10-11 miles deep. Fresh water percolates up through the heated well shafts until it is just below the surface of the ice. Robotic hummingbird water collectors hover over a well shaft, extend the collection siphon into the well and siphon water into the onboard collection tank. Loaded hummingbirds transport the water to purification stations located on the surface of the surface in strategic areas nearby. These purification stations are designed to withstand the hostile environment. At times water collection and purification must be temporarily halted due to violent storms and ice ripples.

Water mining is also accomplished by laser blasting. Using one foot wide laser blasts in the shape of squares to cut into the ice of Europa, harvester ships will help collect the ice. After the laser blasts have been shot from hovering harvesters, workerbots will use their laser sickles to cut under the block of ice to separate it from the surface. The blocks of ice are then loaded into the harvesters, melted, and filtered into usable water. This water is used by the *DSE: Alpha* colony as well as being sold to other colonies, communities, and outposts throughout the solar system.

Illustration 3: Laser Sickle





Square laser blaster onboard harvester ships

Thermal energy collection is accomplished by sending remotely controlled workerbots and power harvesters into orbit around Io (a sister Jovian moon) to tap into the thermal energy released by the volcanic eruption on the surface of Io. Once the energy is stored in the harvesters, they are returned to processing plants onboard the *DSE: Alpha* colony for refinement into usable power for the colony, and the mining operations on the surface of Europa.

Minerals are mined from the asteroids of the Van Allen Belt between Jupiter and Mars. A mobile processing plant is transported by ion drive tugships to the target asteroid and workerbots proceed to mine the asteroid for minerals such as nickel, iron, and smaller quantities of other minerals. Once the minerals have been processed, the raw materials are transported to *DSE: Alpha* to be used in manufacturing.

10d. Mission Four: Exploration of Deep Space

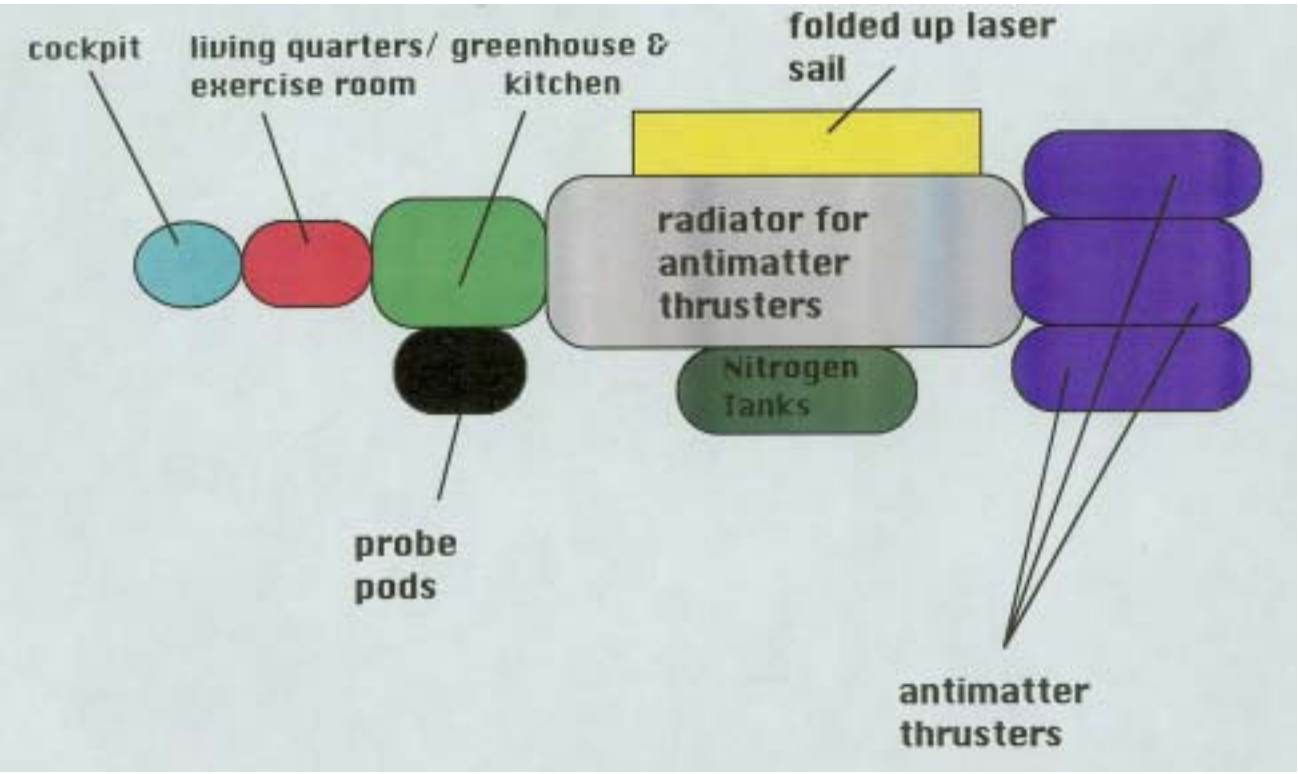


ILLUSTRATION 4: Starcruiser Discovery Omega. Illustration by Alex Hammond.

DSE: Alpha is the home base for *Discovery Omega*, a starcruiser designed for deep space exploration. The spacecraft is designed for a crew of seven, to explore our solar system and beyond. Destinations on slate for exploration by the crew of

Discovery Omega include: a close look at Jupiter and it's major moons; observance of Triton, the largest moon of Neptune; Umbriel, the fourth moon of Uranus; Quaoar and Sedna, two planetoids in the outer solar system; the Van Allen Belt; and the Kuiper Belt.

The main thrusters of *Discovery Omega* are antimatter engines, which change liquid nitrogen to positive and negative particles to power the craft. As a secondary engine, a laser sail, which can use any form of light for power, will be folded on top of the craft and will be unfolded as needed. The craft was constructed on Luna One and assembled at *DSE: Alpha*, in orbit around Europa. *Discovery Omega* contains a greenhouse, three laboratories, an exercise area, and missiles in case of an emergency. To test the chemical composition of asteroids, comets, and other bodies, space probes can be launched from the craft. Discovery Omega features laser cutters, thermal imaging cameras and chemical testing apparatus.

11. Inside the colony

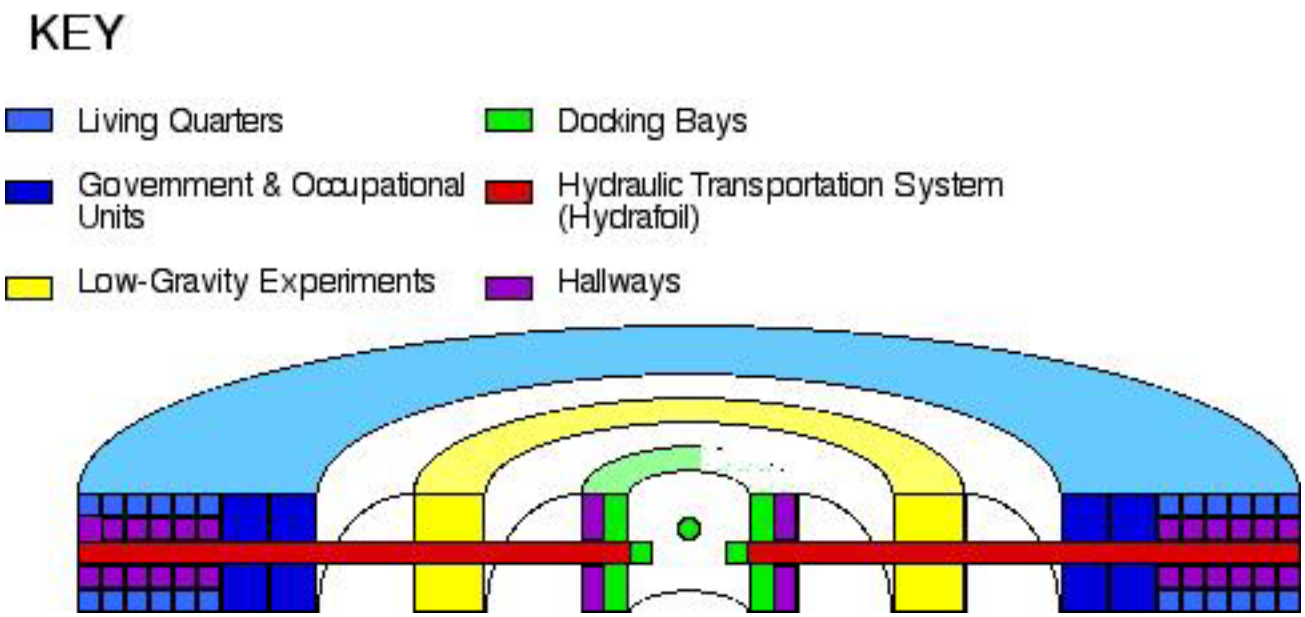


ILLUSTRATION 5: Cross-section of DSE: Alpha toruses. Illustration by Kelly Baldwin.

DSE: Alpha is a hub and spoke colony made up of three concentric toruses around a central hub. The living quarters occupy the outer rim of the colony, which allows the occupants to enjoy the views of space which can be seen from the outer rim. Government and occupational units are located below the 1G line of the outer torus. Governmental and occupational units occupy the second torus. All manufacturing, processing, research, and experimentation takes place on this level. Docking bays

are on torus three. The outer torus consists of three stacks: the living quarters stack; the entertainment, sports, and physical fitness stack; and the ZORM (Zoological Orbital Research Module) stack.

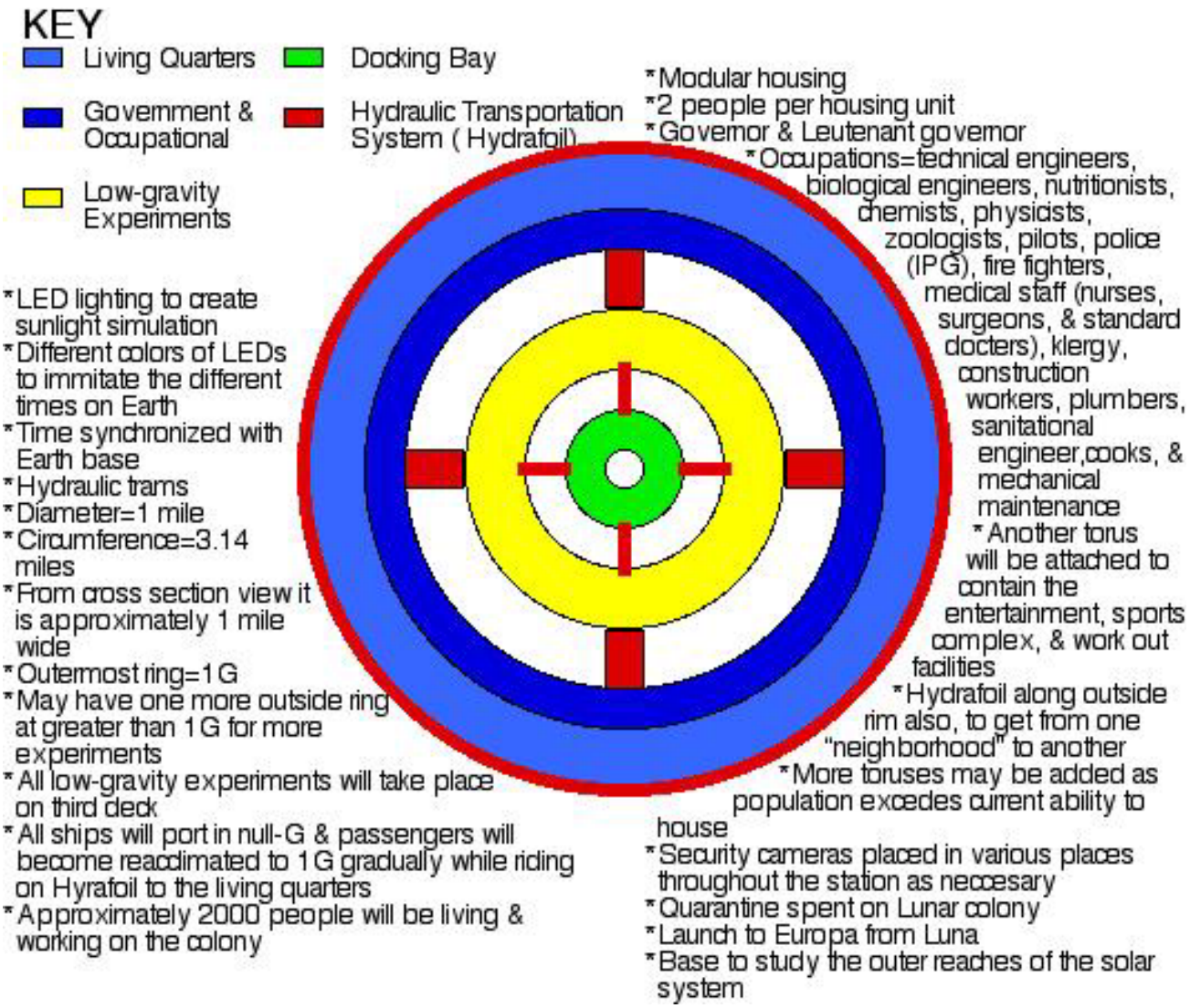


ILLUSTRATION 6: Top view of DSE: Alpha. Illustration by Kelly Baldwin.

11a. Government

DSE: Alpha is a colony of the United States of America. Therefore, all laws, rights and restrictions which govern the United States, also govern DSE: Alpha. Leadership for the colony is provided by an elected Governor and Lieutenant Governor. The citizens of DSE: Alpha are represented by one senator and one congressman in the United States House of Representatives. *DSE: Alpha* also has a representative on the

IC (Interplanetary Council). On a more local level, the citizens elect representatives to the Colonial Council, which provides for a means of legislating the local government of the colony.

11b. Religion

DSE: Alpha assures its citizens of the same freedom of religion that citizens of the United States have. A religious center is provided for each community. The amount of space allotted to each religious affiliation is based on the percentage of the population who practice that particular religion. All religions recognized by the United States are recognized in the colony.

11c. Security/Medical resources

Local Police kiosks are located in each community. The colony has an almost 100% crime-free environment, due to the number of security checks each citizen must be submitted to before arriving in the colony. Prior to arriving in the colony, potential citizens undergo a complete top-secret level background check, as well as a psychological evaluation. Once the checks have been cleared, potential citizens must be quarantined at *Lunar One Base* for a period of three months. This quarantine insures that potential citizens are virus-free and also allowed extra time for background checks to be further investigated. Potential citizens are body-scanned at Lunar One Base. Optical, DNA, and Palm Scanprints are forwarded to the colony one month prior to a new colonist's arrival. Clearances and credcards are coded and ready for new colonists when they first arrive at the colony. Visitors undergo the same procedures.

Surveillance cameras keep close check on all corridors, buildings, and facilities. Nanocameras are embedded in the walls of sensitive areas. Corridors are equipped with motion detectors which are activated at night. Police officers patrol the corridors on hoverboards.

Citizens who create problems on DSE: Alpha have nowhere to run. In this closed environment, their detection is guaranteed. In the event that someone does commit a crime, there are only a few options. [1] citizens/visitors who commit a business crime are immediately dismissed from the colony, and transported to Earth on the first available interplanetary shuttle. [2] citizens/visitors who commit a social crime – at home or in public – are kept in a lockdown unit at the Central Police Headquarters in Torus

3., until a judge/jury trial has been conducted and a decision has been made as to the guilt or innocence and the sentence. Minor offenses are given a second chance. All major offenses and all second chance failures are dismissed from the colony and transported back to Earth on the next available interplanetary shuttle. Former citizens being transported to Earth will be placed in cryogenic freeze chambers until their arrival on Earth and taken by Earth authorities.

There is no room on *DSE: Alpha* for criminals, and they are not welcome.

11d. Education

Professors teach all grade levels and college levels in the colony. Education takes place in public community schools. A LAN (Local Area Network) is provided for classrooms. Several grade levels might occupy a classroom at the same time. All student desks are situated in a circle around the professor's platform. Professor's teaching platform rotates slowly so he or she faces all of the students many times during the class session. Holographic Teachers (guest speakers and maybe substitute professors) are frequently projected onto the professor's platform for special learning sessions.

Each student's desktop is also a computer monitor with touchscreen and keypad capabilities. Assignments and class notes are uploaded to student terminals by the professor. Classwork, homework, and tests are uploaded to the professor's terminal by the students. Each student also has a computer system at home.

11e. Employment/Research

Employment on *DSE: Alpha* is extremely varied and plentiful. Most citizens who make the grade and choose to live and work in the colony do not leave until retirement. Off-colony retirement is mandatory. When retirement age has been reached, citizens are relocated to Earth with full pay and benefits.

Some of the positions available in the colony are engineers, pilots, mechanics, technicians, professors, scientists, zoologists, security forces, domestic workers, nutritionists, clergy, medical personnel, restaurant workers, entertainers, and many others. Workerbots (robotic workers) are used for menial tasks and work outside the colony. Most highly-skilled employees work in Lower Torus One.

Uniforms are worn on the job. You choose what you want to wear after hours. All uniforms are white in color initially, and made of carbon nanotube fabrics, which are

self-cleaning, self-repairing, and color changeable. Once you receive your uniform, you are also given a shoulder patch which identifies your job. The patch is designed to program the uniform to be a certain color and design according to your job. The patch cannot be removed from the uniform until you change jobs or earn a higher rank. Only a manager can remove or change the patch.

Credits are issued as payment for work. No currency is used in the colony, only credcards. Pay is automatically credited to your account and purchases are automatically taken from your account. Credcard readers are located throughout the colony.

11f. Housing

Citizens and visitors of the colony live in modular, efficiency (single room) homes. All modules are equipped with a multipurpose area for relaxation, entertaining guests, study and physical exercise. Each module is equipped with a changing/closet/bathroom area. Modules do not have kitchens, although small refrigerating units and food processing units are included. All modules are designed to accommodate two people. Doors to each module opens into the main corridor for that community. Life in the modules is similar to dormitory life. As a family unit grows, another module may be requested. Nanotech walls allow corridor doors to seal and new doors (connecting two modules) to open.

Kiosks at frequent intervals throughout the communities provide healthy foods for between-meal snacks. Community cafeterias provide three meals per day, eliminating the need for individual kitchens in the housing modules. Housing modules are self-cleaning and voice-activated climate control. Vidscreens are built into the nanotech walls for use as entertainment centers, screensavers, or information centers. Wall decor and color can be programmed to the desires of the occupants.

11g. Entertainment

Torus Two is home of the most grand entertainment complex in the solar system. *DSE Disney* tops the list. This Disney attraction features a combination of virtual rides and a physical rollercoaster unlike anything you have every ridden. This coaster takes you on a ride completely around Torus Two (3.14 miles), twisting and turning to the inside of the colony as well as snaking its way along the outside rim of Torus Two. Nanotech Shields provide protection from the elements of space as you emerge from

the colony and see the spectacular panoramic view of Europa, Jupiter and the vastness of space.

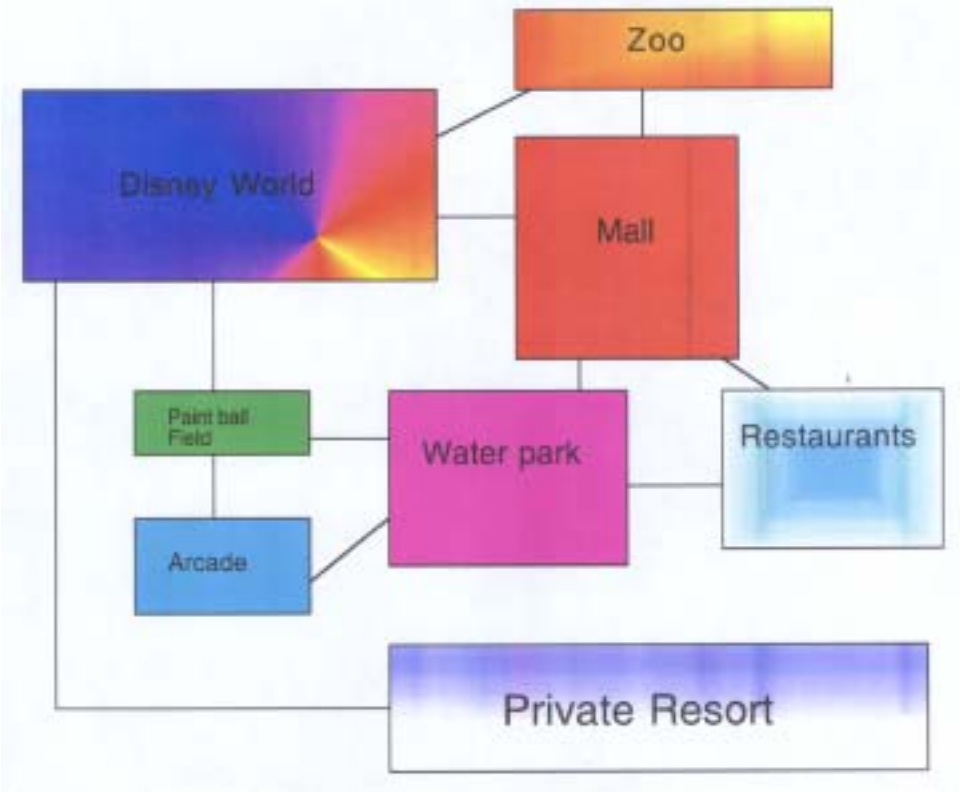


Illustration 7: Entertainment Complex. Diagram by Hampton Robinson

Other attractions in the complex include: [1] A zoo features many of the endangered animals being cared for in the ZORM section of DSE: Alpha. Zoo animals are rotated out of the zoo and back to ZORM frequently, to ensure that the best of health and habitat are maintained. [2] A Water Park which also doubles as a water processing facility for the water collected from Europa. This park is constructed of nanotech materials which allow it to be programmed to simulate water parks and beaches on Earth. [3] Paintball and lasertag park with the latest in paintball and laser technology. Rumble suits equipped with hundreds of sensors allow the participants to feel the "rumble" of a direct hit. [4] Vidgame and virtual gaming arcade for the diehard gamer. [5] A resort area featuring a 200-room luxury hotel, numerous swimming pools, and scores of fine dining and fastfood restaurants. The *DSE Ritz Resort* is a favorite among colonists, as well as among visitors to the colony. [5] The DSE Mall – the latest in technology and fashion. If you can't find it at "The Mall", you can't find it. Nanotech clothing allow you to design your own unique fashions and wear them home.

11h. Sports complex

Also on Torus Two is the DSE Sports Complex featuring the best in interplan-

etary sports. [1] Arena football; [2] Indoor soccer; [3] Tennis, racquetball, and handball courts; [4] Pod racing track which parallels the Disney coaster on a circuit which takes it completely around Torus Two. (Don't worry – there no danger of crashes and holes being blown through the walls. These pods are on individual tracks. No contact between pods.) [5] Aquatic center; [6] Basketball courts; [7] Hockey and ice skating rinks and [8] a Fitness Center. All for one low admission price – free! Just one of the benefits of living or vacationing in the colony.

11i. Food production

Although the primary mission of ZORM (Zoological Orbiting Research Module) is research and development in the area of Endangered Species Preservation, an added benefit of ZORM is food research and production. ZORM occupies the bottom stack of the entire Torus One. Hydroponic gardens hang from the ceilings of ZORM like moss from the trees of a lush green forest. A variety of hydroponically-grown fruits and vegetables are served in the restaurants, the cafeterias, and the healthy food kiosks throughout the colony. All of the fruits and vegetables are processed right here in ZORM. Main staples of food production are: tuber plants (such as potatoes and sweet potatoes), beans, corn, lettuce, tomatoes, corn, soy, peas, peppers, rice, cane, peanuts, pineapples, apples, bananas, grapes, and oranges.

Protein is processed using synthesis and replacement protein methods. Protein foods (similar to meat products) and replacement protein foods (such as soy and peanuts) are researched, developed and produced in ZORM. *No animals were harmed in the making of DSE; Alpha.* Dairy cows and other domestic animals are part of ZORM, but most dairy products are synthetically produced.

11j. Energy and resources

Most of the power for *DSE: Alpha* is provided through thermal energy collection, energy-collecting solar panels, and hydroelectric generation. Hydroelectric power generators on Europa take maximum advantage of the enormous amount of water available for use by *DSE: Alpha* and other outposts. A portion of the Europan water is transported to the colony for processing on-site. The same vessels used to transport water for consumption, also transport water for power generation.

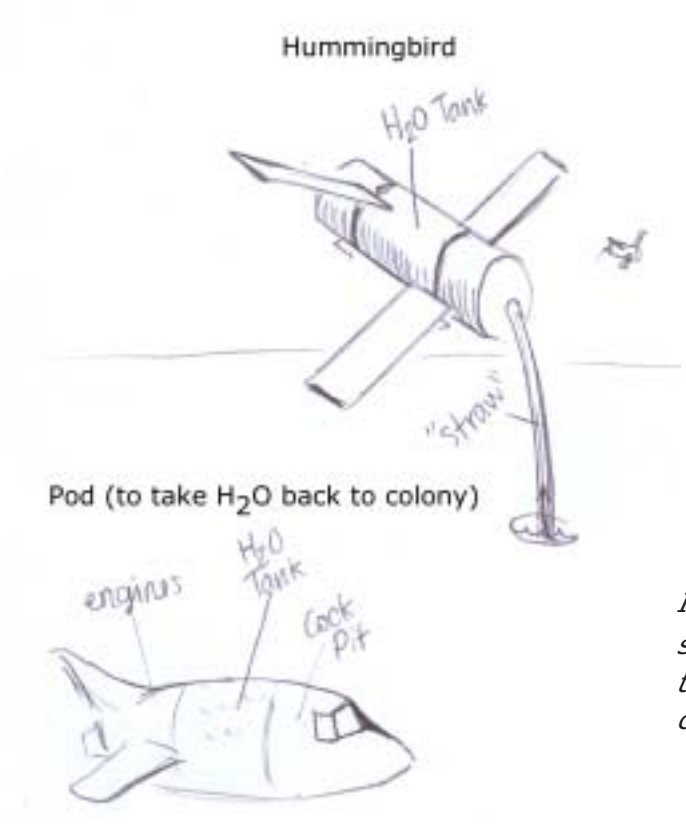


Illustration 8: Water collectors. Water is siphoned from the wells of Europa and transported in Water Pods back to the colony. Illustration by Kelly Baldwin.

Power is also produced using solar panel arrays strategically placed on and near the colony. Solar energy is stored in cells along the rim of Torus One.

11k. Transportation

[1] Transportation to and from *Lunar Base One* and other space communities and outposts is accomplished aboard ion-drive space shuttles. Docking bays are located along the inner core of DSE: Alpha. Fueling stations are located just outside the colony at the top and bottom of the inner core.

[2] Transport from the docking bays to the toruses is accomplished by means of a hydrofoil system. The hydrofoil tube is located in the spokes of the colony. This enclosed train is pulled through the tube by forced water, with stops at each of the three toruses. The procedure is reversed to return the tubetrain to the docking bay area.

[3] Moving sidewalks can be accessed anywhere in the colony. pedestrian boulevards are located between each row of community homes and businesses. At the center of each boulevard are a pair of moving sidewalks. One sidewalk moves one direction and one the other direction. The sidewalks encircle each torus.

[4] Personal hoverboards are also available. By far, the most popular form of transportation is walking.

11l. Shield

A protection shield of carbon nanotube construction enclosed the entire colony like a huge bubble. This bubble is 4 miles in circumference. This shield is designed to filter the space around the colony. Pollutants and chemicals are allowed to pass through the bubble to the outside, but space debris, chemicals, and harmful rays are not permitted to pass through the bubble to the inside. The shield has been programmed to separate in order to receive incoming space shuttles, and heal itself after the shuttle shave passed. The shield also serves as a protective barrier against micrometeorite impacts. Should the shield become torn, it will repair itself.

12. List of Figures and Illustrations

13. References

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